NASA GODDARD SPACE FLIGHT CENTER

GMSEC

GSFC Mission Services Evolution Center

August 2003; Edition No.2

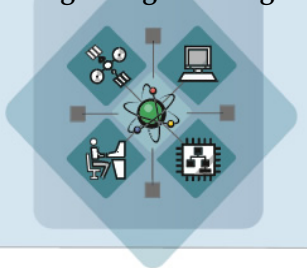
GMSEC Headlines

The GSFC Mission Services Evolution Center (GMSEC) is a coordinated effort across multiple NASA GSFC development organizations to provide data systems and services to NASA's Earth and Space Science Enterprise missions. Key to the GMSEC concept is its reference architecture designed to reduce system integration costs, increase system capability, and simplify technology infusion over time.

Importance of Demos

- Show tangible progress to those planning to use the GMSEC concept
- Explain GMSEC to a wider audience
- Baseline the development effort
- Recognize the efforts of the many GMSEC civil servants and contractors
- Solicit critique and new ideas
- Prompt design and ops concept discussion

GMSEC "Headlines" is prepared monthly to highlight key GMSEC accomplishments or areas of progress and interest. Current and past issues of Headlines are available on-line at **gmsec.gsfc.nasa.gov**.



GMSEC Demonstration Validates Advanced Ground System Architecture

Key Milestone Met

The second major demonstration of the Goddard Mission Service Evolution Center (GMSEC) system was held on schedule during July and August 2003. Over 100 people attended the progress presentation and system demo in the GMSEC Lab in Building 23 at GSFC/NASA. The audience included representatives from new and existing missions, GSFC Information Systems Division management, and civil servant and contractor personnel interested in new mission data system approaches.

The GMSEC system now utilizes a baselined set of standard messages and applications programming interfaces (APIs) and consists of over a dozen components operating over a network using multiple middleware messaging systems. Demo 1, in February 2003, showed basic publish/subscribe communications using a single middleware package.

GMSEC Message Standards and API used by COTS and GOTS Components

GMSEC message standards continue to be developed by a large team of civil servants, contractors, and vendors. Applications adhering to the standards are easily added to the GMSEC configuration. APIs have been defined and coded to provide a consistent

mechanism for communicating with the GMSEC messaging (middleware) system. The API is currently provided for C, C++, and Java. During the demonstration, TIBCO Rendezvous, TIBCO SmartSockets and Interface Control System's Software Bus were used as different middleware. The GMSEC team developed a "bridging" tool so all three systems can be used at once. The standard messages included in the demo were event/log messages, directive messages and directive response messages.

Ease of Integration Proven

An important goal of the GMSEC architecture is to reduce the effort required for system integration. The consensus among the developers was that the integration effort was considerably easier than with traditional system designs - sometimes "working on the first try." With GMSEC, components integrate with the middleware using the APIs; components do not need to integrate with each other.

NASA GSFC Mission Services Evolution Center, Code 581
http://gmsec.gsfc.nasa.gov
email: Dan.Smith@nasa.gov

Groundwork Laid for Automation

Allowing components to issue directives to other components and to accept directives for processing is the first step towards GMSEC automation. For Demo 2, this was demonstrated visually by having one system call up displays on another system and by automating a session between the planning and scheduling system and the flight dynamics system. In the future, all system components may be controlled from a single user position and components monitoring the system and satellite status will recognize issues and automatically issue directives to respond to the situation.

More Components Becoming GMSEC-Compliant

The demo used over a dozen COTS and GOTS packages using GMSEC-compliant messages. To be GMSEC compliant, components must use a standard set of messages to interface to the middleware bus – creating a plug-and-play capability. Components covered five ground system domain areas:

Telemetry and Command (T&C): Three telemetry and command systems operated simultaneously in the demonstration. Two GOTS packages, ASIST and ITOS, handled single spacecraft simulations, and L-3 Storm's InControl-NG COTS T&C system supported a simulated constellation of four spacecraft. GMSEC supports operations concepts involving multiple T&C systems and satellite constellations operating on the same information bus.

Flight Dynamics: Autonomous Flight Dynamics System (AutoFDS) is a web-based tool for autonomous generation and distribution of flight dynamics products, including precision orbit determination. The flight dynamics products were generated on demand when the scheduler (AMPS) issued a directive to AutoFDS. AutoFDS generated the products and issued a message back indicating completion status and file location.

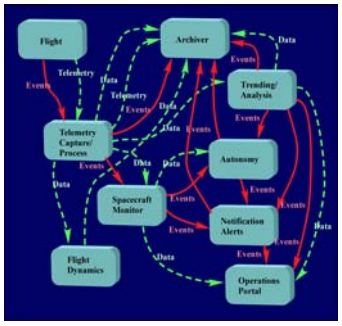
Assessment: Assessment was performed by two tools, the Exception Monitor and the GMSEC Reusable Event Analyzer Tool (GREAT). Both tools subscribe to the same log messages. GREAT displays and archives the messages. The Exception Monitor, which is particularly useful for monitoring constellations, analyses the messages and provides a high level "red-yellow-green" display that the user can drill down into to find the source of any higher-level alerts.

Planning and Scheduling: Automated Mission Planning and Scheduling (AMPS), a planning and scheduling server that incorporates abstract planners, sophisticated station scheduling algorithms, and object-oriented domain models to support multi-satellite missions, worked with the AutoFDS flight dynamics package during the demo to schedule and update ground system contact times based on flight dynamics products.

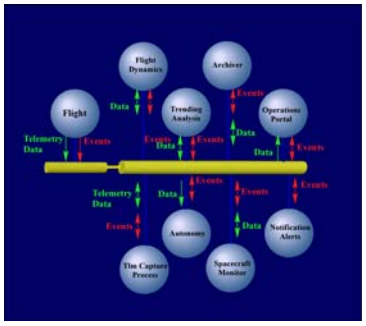
Simulation and Modeling: The demonstration was driven by two simulation tools - Scalable Integrated Multi-mission Simulation System (SIMSS), which generates multiple telemetry data streams and routes the data through socket connections, and Dynamic Simulator (DSIM) which ran in the GSFC Formation Flying Test Bed (FFTB) and provided SIMSS with the navigation data for the demo. Both simulation tools received and processed directives, and generated directive responses and log messages.

GMSEC Future is Taking Shape

GMSEC continues on track for a mature ground system capability in late 2004 and plans are underway to move some of the concepts to GSFC's flight software architecture. The concepts are being proven, more components are becoming available, and COTS vendors are taking notice. Demo 2 progress has convinced the GMSEC development team that GMSEC does represent a new an efficient approach for satellite mission data systems development. Watch for details on the GMSEC Team and the GMSEC components in future issues of GMSEC Headlines.



Typical Socket Connected Ground System



GMSEC Middleware Approach

Fall Demo Planned

The next demonstration scheduled for October/November will include standard messages for telemetry frames, data value requests and data value distribution. Also, Java Messaging Service will be used to provide an open source alternative for the middleware. Additional components including attitude determination and data analysis tools will be added. Finally, additional languages for the API will be supported including Perl, MatLab and Python.

//

Past Issues of GMSEC Headlines

July 2003: "COTS Vendors Supporting GSFC Ground System Efforts"